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CASE REPORT

REHABILITATION CONSIDERATIONS FOR AN UNCOMMON INJURY OF THE KNEE: A CASE REPORT

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ABSTRACT

Background and Purpose: Chronic instability of the proximal tibiofibular joint (PTFJ) is an uncommon condition that accounts for <1% of knee injuries. The mechanism of injury is a high-velocity twisting motion on a flexed knee. Surgical management is controversial due to complications; however, surgeons are now utilizing ligament reconstruction to restore stability. There is a paucity of information in the literature regarding postoperative care and rehabilitation after PTFJ reconstruction. The purpose of this case report is to describe the post-surgical rehabilitation for an adolescent athlete following PTFJ ligament reconstruction using a modified anterior cruciate ligament reconstruction (ACL) post-operative rehabilitation protocol.

Case Description: A 15-year-old female soccer player reported left ankle and knee pain for one year after a contact injury and landing on a hyperflexed knee during a soccer game. The surgeon diagnosed the subject with chronic PTFJ instability and performed reconstruction using an allograft ligament and calcium phosphate bone graft. The subject presented to physical therapy three weeks post-operatively with complete resolution of ankle pain and mild knee pain. The subject's goal was to return to golf as she reported apprehension with a potential return to soccer. After consulting with the surgeon and because the subject was only allowed to advance weight bearing status by 20 pounds each week (to protect the graft site), the treating therapists progressed the subject using a modified ACL protocol as there is no documented post-operative rehabilitation protocol to treat patients after a PTFJ reconstruction.

Outcomes: Outcome measures for this subject included the patient specific functional scale (PSFS), verbal numeric pain rating scale and ability to participate in golf. The initial PSFS score was 4/30 (activities included walking, jogging and golf) and the subject's reported pain level was 3/10. Three months after surgery the subject demonstrated significant improvement to 30/30 on the PSFS, 0/10 pain, and had progressed to participation in both golf and jogging.

Discussion: The modified ACL protocol was effective in safely rehabilitating this adolescent athlete following a PTFJ reconstruction. This subject demonstrated some yellow flags which may have slowed her rehabilitation progression. Use of a modified ACL reconstruction protocol served as a guideline for the rehabilitation of this rare condition. Additional research is necessary to establish evidence-based guidelines for treatment of PTFJ reconstruction.

Level of Evidence: Level 4

Key Words: Lateral knee pain, proximal tibio-fibular joint reconstruction, tibiofibular joint instability

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INTRODUCTION

The proximal tibiofibular joint (PTFJ), located distally and laterally to the knee joint, is a plane synovial joint. The PTFJ is between the articular facet on the lateral condyle of the tibia and the facet on the head of the fibula.[1] It is designed to rotate a small amount in order to accommodate the rotational stress at the ankle joint that occurs during dorsiflexion.[2] It is heavily supported by surrounding ligaments and is rarely injured. The common peroneal nerve travels laterally around the fibular head and can easily be disrupted if instability at this joint is noted. PTFJ instability is extremely rare, accounting for <1% of all documented knee injuries.[2] When a PTFJ injury does happen, it typically occurs in athletes. Disruption of the proximal capsular ligaments occurs with sudden internal rotation and plantar flexion of the foot with an externally rotated tibia and flexed knee. Although a rarity, PTFJ instability can cause pain and functional deficits that persist for months after the initial injury.[3]

The PTFJ has received little attention in the literature. Therefore this condition is often underdiagnosed and the best treatment is unknown. PTFJ instability can be easily mistaken for lateral knee pain syndrome and has only subtle abnormalities on radiographs. Patients with PTFJ instability often complain of lateral knee pain; however, ankle motion can also increase knee symptoms.[2] In some cases a bony protrusion is noted at the lateral knee and knee range of motion may also be affected.[4] The confusing clinical presentation does not allow a practitioner to clinically diagnosis such an injury so further testing may be necessary to obtain an accurate diagnosis. PTFJ instability is typically missed on unilateral plain radiographs.[2] If a clinician is considering PTFJ instability a bilateral radiograph or advanced imaging is suggested. A bilateral radiograph (compared to a unilateral film) allows for easier detection of a displaced fibular head when able to compare to the uninvolved lower extremity.[5]

PTFJ instability is categorized into four different types; subluxation (type I), anterolateral dislocation (type II), posteromedial dislocation (type III), and superior dislocation (type IV).[6] Type II, the most common type of instability, frequently results in ligamentous injury and peroneal nerve palsy due to the peroneal nerve's path around the fibular head. Treatment options for PTFJ instability include conservative care or surgical interventions. In previous cases found in the literature, there has been some success with reduction of the fibular head, casting the leg for one week, then a progression of four weeks to full weight bearing for acute dislocations (type II-IV).[5] However, some cases require surgical interventions due to the chronic condition and late diagnosis.[11] Surgical management is controversial. Many surgical approaches can cause complications such as lateral knee instability, peroneal nerve palsy, hardware failure, and ankle pain. To avoid the common complications, surgeons are now utilizing ligament reconstruction of either or both the anterior and posterior tibiofibular ligaments to restore knee stability. However, there is little to no information on rehabilitation techniques post-surgery.

There is a distinct lack of treatment guidelines for patients with PTFJ instability. Therefore, the purpose of this case report is to describe the post-surgical rehabilitation for an adolescent athlete following PTFJ ligament reconstruction using a modified anterior cruciate ligament reconstruction (ACL) post-operative rehabilitation protocol.

CASE DESCRIPTION

The subject was a 15-year-old female soccer player referred to physical therapy three weeks after PTFJ reconstruction. She sustained a contact injury during a soccer game and reported worsening left ankle and lateral knee pain over the course of a year. There were 13 months between the initial injury and the subject's surgery. She was seen by multiple providers and had attempted physical therapy without success. The subject continued to have pain and was unable to participate in her usual level of activities. After magnetic resonance imaging indicated bone barrow edema surrounding the PTFJ the surgeon diagnosed a type I PTFJ injury. The surgeon then completed an allograft ligament and calcium phosphate bone graft for reconstruction.

EXAMINATION

A physical therapy examination was performed three weeks after the PTFJ reconstruction. The subject presented partial weight bearing on bilateral axillary

Table 1. *Strength and range of motion testing.*

	Baseline		Discharge	
AROM	Left	Right	Left	Right
Knee Flexion	105°	160°	160°	160°
Knee Extension	2°	5°	5°	5°
Manual Muscle Testing	Left	Right	Left	Right
Knee Flexion	3+/5	5/5	5/5	5/5
Knee Extension	3+/5	5/5	5/5	5/5

crutches and a left knee hinged brace locked in 0 degrees of extension. The subject reported complete resolution of ankle pain and only mild complaints of lateral knee pain, 3/10 on the verbal numeric pain rating scale (NPRS).

The subject had 1 cm of swelling (compared to non-involved lower extremity) measured at the joint line and the incision was clean, dry, and healing well. The physical examination revealed limited active knee range of motion (ROM) and decreased strength. (Table 1) Manual muscle testing with therapist resistance was deferred at initial examination since the surgeon's prescription did not indicate if there were any post-surgical precautions or contraindications and the subject's apprehension. However, she was able to perform 20 straight leg raises without brace and with no extension lag present. The subject also demonstrated symptoms consistent with a sensory peroneal nerve injury due to mild paresthesia at the lateral leg. She completed the Patient Specific Functional Scale (PSFS), centered around three functional activities, walking, jogging, and golf, scoring a 4/30. The subject's parents reported that she had symptoms consistent with anxiety, but no medical diagnosis had been made. All other screening was negative. The subject's goal for physical therapy was to return to golf as she did not want to return to soccer.

CLINICAL IMPRESSION

The referral to physical therapy had several special instructions and precautions. The subject was allowed to progress her initial partial weight bearing status by 20 pounds per week and could initiate weight bearing as tolerated by six weeks post-operative. The surgeon also recommended quadriceps activation exercises as tolerated and avoiding excessive hamstring contraction. Therefore the subject was progressed by modifying an anterior cruciate ligament (ACL) reconstruction protocol. The protocol was modified to account for the initial weight bearing restrictions as well to allow for soft tissue healing and to avoid displacement of the PTFJ with excessive contraction of the biceps femoris. The ACL protocol was chosen as it is an established treatment program which reflected the restrictions involved in this case. Excessive hamstring activation was cautioned after reconstruction of the PTFJ due to the biceps femoris attachment onto the fibular head. Increased stress to the biceps femoris could potentially cause elongation or disruption of the repaired tissue. The chosen ACL protocol limits hamstring activation for six weeks due to tissue grafting of the ipsilateral hamstring in a traditional ACL reconstruction. With the restrictions in hamstring activation and modifications for weight-bearing restrictions contained therein, the ACL protocol was deemed appropriate for modification and use in this subject.

INTERVENTIONS

During the first six weeks of physical therapy the subject was seen 1-2 times a week. This depended on her functional and objective progress and compliance with her home exercise program which was measured via subjective report. Initial rehabilitation was focused on gait training (with brace on), weight shifting, passive and active assisted ROM (AAROM) of the left knee as well as ankle, hip and core strengthening. The physical therapists provided gait training with bilateral axillary crutches and practiced transferring weight onto the involved lower extremity (using a scale to measure) to ensure that the weight-bearing restrictions were not exceeded during this protective phase.

Passive and active assisted ROM were applied by the treating physical therapist during the early sessions and the subject was instructed to proceed with ROM exercises without pain to mild discomfort three times per day as a home exercise program. Ankle exercises included ankle 4-way ankle resistance using Theraband. Caution was used during this exercise because

there was mild lateral knee pain that was reproduced with resisted ankle eversion. Other exercises that were performed during this initial phase of rehabilitation included quadriceps sets, straight leg raises, side-lying hip abduction/adduction, prone hip extension and other non-weight bearing core and hip exercises as tolerated. The physical therapists deferred any exercise that increased pain over the left lateral knee and/or the fibular head.

At six weeks post-surgery, low level hamstring strengthening was initiated beginning with hamstring isometrics and supine bridging exercises which were progressed to single limb Romanian deadlift (RDL) and stool scoots. During weeks 6-12 bilateral hip, knee and ankle strengthening and dynamic balance exercises were progressed per the protocol, increasing the difficulty of each exercise as the subject was able while maintaining proper form. (Protocol provided in Appendix 1)

During this phase of rehabilitation the subject experienced two episodes of syncope. One episode occurred immediately after a physical therapy appointment, the other occurred at home. The subject was seen by a cardiologist who stated no immediate concern and believed this to be secondary to dehydration and deconditioning. Once the clinicians were aware of the subject's reports of syncope and occasional lightheadedness, the physical therapists adapted the clinical interventions to include multiple timed rest breaks after challenging exercises (up to two minutes in length). After the initial two episodes of syncope, the subject and family denied any other incident. The physical therapists slowly decreased the timed rest breaks during the sessions and the subject did not report any additional episodes of lightheadedness or syncope throughout the rest of the plan of care.

At 12 weeks post-surgery, the subject demonstrated full left knee AROM and full strength throughout the lower quarter with manual muscle testing. Balance was tested using a single limb standing test and the subject was able to hold for over thirty seconds. The surgeon cleared the subject to begin running and plyometric progression. Examples of plyometric exercises included jump downs, broad jumps, lateral bounding and line jumps. As the subject demonstrated a moderate amount of dynamic knee valgus bilaterally and faulty landing mechanics, increased time was spent focusing on safe lower extremity mechanics.

The subject was discharged from physical therapy after 15 total sessions. Functional testing per the modified protocol (Appendix 1) on day of discharge included a single limb hop for distance test. The limb symmetry index was 100%. She was pain free with all activity and had successfully returned to playing golf. She demonstrated independence with her home exercise program as well as confidence in ways to progress the program. She was encouraged to call the physical therapists with any questions or concerns with her individualized program. Her parents were in agreement with the plan and all were satisfied with the subject's current level of function.

OUTCOMES

There were three different patient reported outcome measures used during the treatment of this subject which included the PSFS, NPRS and the ability to participate in golf. The PSFS is a self-report measure that has subjects list up to five activities that are difficult for them to complete or that cause a reproduction of pain.[7] Although the PSFS can be broadly used with many conditions, the PSFS is a useful tool for measuring knee dysfunction. When using this outcome measure with orthopedic knee conditions the PSFS has a test-retest reliability of 0.84 and good construct validity, and the standard error of measure is 1.0 point.[7] The minimal clinically important difference (MCID) is three points.[7]

The subject in this case report had an initial PSFS score of 4/30. Her listed activities included walking (2/10), jogging (1/10) and golf (1/10) as the subject did not want to return to soccer. The total score on the PSFS increased to 30/30 at discharge which shows a clinically significant change in overall function. (Table 2)

The NPRS was also used during the treatment of this subject. The NPRS is an easily administered measure that assesses the subject's average amount of pain in the last 24 hours. They are asked to rate their pain on an 11-point scale with "0" being no pain and "10" being extreme pain. This can either

Table 2. *Change in outcomes.*

	Baseline	2 Months	Discharge	18 Month Follow-up
Patient Specific Functional Scale				
Walking	2/10	10/10	10/10	10/10
Jogging	1/10	9/10	10/10	10/10
Golf	1/10	8/10	10/10	10/10
Total	4/30	27/30	30/30	30/30
Verbal Numeric Pain Rating Scale				
Pain	3/10	0/10	0/10	0/10

be completed via a single 10 cm line or asked verbally. In this subject's case it was addressed verbally at every treatment session. In patients who have knee pain, it has been suggested that the MCID is 1.2 points.[8] Although the subject never complained of high amounts of pain, her initial pain rating was 3/10 and decreased to 0/10 at the left lateral knee at discharge.

DISCUSSION

Proximal tibiofibular joint instability is a condition that is rarely encountered by the physical therapist. This diagnosis receives little attention in the literature, but can cause pain and functional deficits for months after injury due to the fact that it is under recognized and often misdiagnosed.[3] Even when correctly diagnosed, management is controversial.[6] Conservative options have included avoidance of athletics, taping, bracing, strapping, and strengthening of the hamstrings, gastrocnemius and soleus muscles. Surgical techniques have included arthrodesis of the superior tibiofibular joint, resection of the proximal aspect of the fibula and temporary internal fixation, all of which have early and late complications such as peroneal nerve injury, post-operative ankle pain and instability and knee instability.[9] Due to these mixed results, soft tissue reconstruction of the PTFJ ligaments has been recommended for adolescent patients.[3,9] This technique has been reported to be safe and effective, however, the post-operative rehabilitation has not been described.

In this case report, the authors demonstrated that using a modified ACL program was safe and effective following soft tissue PTFJ reconstruction for this subject. The treatment program resulted in full functional recovery for this subject and allowed the subject to return to her desired sport at her final follow up assessment. The modified ACL protocol was chosen because it most closely matched the specific instructions and restrictions provided by the surgeon.

Three months after surgery, the subject demonstrated clinically significant improvement on the PSFS, reporting 0/10 pain on the NPRS, full pain free knee range of motion, and normal lower quarter strength with manual muscle testing. She did not report any instability at her PTFJ. The subject was able to complete a unilateral squat without excessive dynamic valgus and was cleared for jogging and chipping from the physician. Her progress during rehabilitation was slowed down due to her activity-related fear and two episodes of syncope.

There are several limitations to this case report that limit the strength of the results. This report is only on one individual's condition and response to treatment and therefore cannot be generalized. Because of the inherent design and limitations of a case report, a cause and effect relationship cannot be inferred from the treatment and the subject's successful outcomes. Additionally, the subject's young age and activity level were favorable conditions for a successful outcome.

CONCLUSIONS

Although PTFJ instability is rare it is important to have a well-documented and progressive plan for progressions with these patients to achieve best outcomes. These results suggest that using a modified ACL protocol may be a viable treatment option following PTFJ reconstruction for an adolescent athlete. This is a case report on one subject following PTFJ reconstruction, and there is a paucity of literature on this condition. Therefore further research, including controlled clinical trials and documentation of long-term outcome data, are warranted.

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Appendix 1. *Modified ACL Reconstruction Rehabilitation Protocol*

Rehabilitation Precautions/General Considerations

- Brace settings as stated below
- Brace locked in 0° extension at night for first 2 weeks to prevent flexion contracture
- No resistive hamstring exercises for 6 weeks (if hamstring autograft)
- Isotonic strengthening: 90°-40° open kinetic chain (OKC) to avoid patellofemoral irritation and ACL strain
- Begin ROM progression from AAROM to AROM (to prevent excessive hamstring activation)
- Progression is criterion-based taking in consideration tissue healing times, patient comorbidities, and using clinical reasoning
- Driving
    - if surgery on left leg → 2 weeks if off pain meds and not driving standard/stick shift
    - if surgery on right leg → surgeon will clear at 5-6 week follow up appointment

Weeks 0-2 (post-op days 1-14)

Weight Bearing/Brace

- NWB first week, PWB at 20 pounds
- Brace locked in 0° extension

ROM

- Full passive knee extension
- Full passive knee flexion

Treatment

- Quad sets
- Ankle pumps
- 4-way SLR (perform while wearing brace locked in 0° extension until physical therapist determines good quad tone/minimal quad lag)
- Seated heel slides with opposite lower extremity assist
- Long-sitting gastrocnemius/hamstring towel stretch
- Heel prop for extension (10-15 minutes, 2-4 sets/day) → progress to passive overpressure of 5-10 lbs. at distal thigh
- Multi-angle isometrics for knee extension at 90° and 60°
- NMES for quadriceps (0° extension)
- Scar mobilization
- Manual patellar mobilization
- Modalities as needed for pain control
- Mini squats (0-30°) (week 2)

Goals to Progress to Next Phase

1) Superior patellar glide with quad set
2) AROM knee flexion to 90°
3) Full knee extension
4) SLR with minimal to no quad lag

Weeks 3-4 (post-op days 15-28)

Weight Bearing/Brace

- Progress PWB by 20 pounds per week

ROM

- Full active assisted knee range of motion

Treatment

- Continue with OKC AROM and PROM exercises
- Continue with OKC PREs for hip, knee, ankle
- Mini squats to 45° knee flexion
- Progressive closed chain exercises (lunges in protected range, step ups/step downs, resisted side stepping, leg press, etc.)
- Bilateral standing heel raises
- Weight shifts
- Trunk strengthening/lumbopelvic stability exercises
- PWB Shuttle/Total Gym to 45° knee flexion
- Stationary bike (no resistance)
- NMES for quad strengthening (isometric knee extension at 60°)
- Manual therapy as appropriate to normalize scar and patellar mobility
- Passive stretching/overpressure to normalize knee extension ROM
- Begin balance/proprioception/neuromuscular control exercises

Appendix 1. *Modified ACL Reconstruction Rehabilitation Protocol (continued)*

Goals to Progress to Next Phase

1) Good quad set
2) AROM 0-120°
3) Minimal to no edema
4) No extension lag with SLR
5) No exacerbation with PWB strengthening

Weeks 5-6 (post-op days 29-42)

Weight Bearing/Brace

- Continue to increase weight bearing by 20 pounds each week. Weight bearing as tolerated by 6 weeks

ROM

- Full AROM

Treatment

- Normalize gait
- Progress FWB flexion up to 90° knee flexion as tolerated
- Progress CKC strengthening
- OKC knee extension 90-40° with resistance
- 6 weeks: initiate hamstring strengthening (isometrics, bilateral hip bridge, bilateral stool scoots)
- Continue with trunk strengthening/lumbopelvic stability exercises
- Exercise bike with resistance for endurance

Goals

1) Full ROM
2) Normal gait
3) No reactive effusion or instability with WB exercises
4) Single-leg squat to 60° with proper alignment/eccentric control

Weeks 7-8

ROM

- Continue to address as needed focusing on restoring symmetrical flexibility

Treatment

- Continue and progress WB and NWB strengthening as appropriate
- Continue and progress balance/proprioception/neuromuscular control exercises
- Progress hamstring strengthening
    - 7 weeks: SL RDL, SL hip bridge, SL stool scoot
    - 8 weeks: Standing/prone isotonic hamstring strengthening
- Begin PWB shuttle plyometrics (progress from bilateral to unilateral)
- Bilateral hop downs and vertical jumping with emphasis on proper landing mechanics (soft landing with trunk, hip, and knee flexion/no dynamic valgus)
- 8 weeks: ok to initiate loaded flexion >90° for functional squatting if desired
- Initiate walk-jog progression
    - Ensure no gross antalgia
    - Audible rhythmic heel strike pattern with good control/stability

Weeks 9-10

ROM

- Continue to address as needed focusing on restoring symmetrical flexibility

Treatment

- Continue and progress WB and NWB strengthening as appropriate
- Continue and progress balance/proprioception/neuromuscular control exercises
- Russian eccentric hamstring curls
- Initiate full weight bearing plyometrics
    - Bilateral
    - Straight plane
    - Stable surface
- Gradually progress FWB plyometrics as appropriate focusing on mechanics
    - Bilateral → unilateral
    - Straight plane → multidirectional/rotational
    - Stable surface → unstable surface

Goals to Progress to Next Phase

1) No pain or reactive effusion/instability with plyometrics and jogging

Weeks 11-12

ROM

- Continue to address as needed focusing on restoring symmetrical flexibility

Appendix 1. *Modified ACL Reconstruction Rehabilitation Protocol (continued)*

Treatment

- Continue and progress WB and NWB strengthening as appropriate
- Continue and progress balance/proprioception/neuromuscular control exercises
- Continue with jogging progression
- Swimming (12 weeks)

Weeks 12-16

Treatment

- Continue and progress WB and NWB strengthening as appropriate
- Continue and progress balance/proprioception/neuromuscular control exercises
- Continue with jogging progression
- Sport specific drills, agility training (begin at 50-75% intensity)

12 weeks post-op

- Functional single-leg hop testing (wearing functional brace)
    - Criteria to initiate functional testing
        - Full ROM
        - Normal gait
        - No effusion
        - Hop up and down on surgical leg without pain
        - Patient has been issued functional brace from surgeon
    - Functional testing
        - Single hop for distance
        - Triple hop for distance
        - Triple crossover hop for distance

Abbreviations:

ROM: Range of motion
AROM: Active range of motion
AAROM: Active range of motion
PROM: Passive range of motion
NWB: Non-weight bearing
PWB: Partial-weight bearing
SLR: Straight leg raise
NMES: Neuromuscular electrical stimulation
RDL: Romanian dead lift
FWB: Full weight bearing
CKC: Closed kinetic chain
OKC: Open kinetic chain